

Population Dynamics and Infection Patterns of *Pallisentis* in *Channa punctata* from Muzaffarpur District, Bihar, India

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ABSTRACT

The present study was conducted to investigate the occurrence, prevalence, and population dynamics of *Pallisentis* spp. infection in *Channa punctata* collected from Muzaffarpur District, Bihar, India. A total of 180 fish specimens were examined during summer, monsoon, and winter seasons. Intestinal acanthocephalans were recovered, identified, and analyzed using standard epidemiological indices. The overall prevalence of infection was 49.44%, with a mean intensity of 4.22 and mean abundance of 2.17. Seasonal analysis revealed the highest prevalence (63.33%), mean intensity (5.18), abundance (3.28), and infection index (328.11) during the monsoon season, indicating favorable conditions for parasite transmission. Statistical analysis showed significant seasonal ($\chi^2 = 8.74$, $p = 0.013$) and size-wise ($\chi^2 = 11.64$, $p = 0.003$) variations in infection, whereas sex-wise differences were not significant ($\chi^2 = 1.82$, $p = 0.177$). Larger fish (20–25 cm) exhibited higher prevalence and parasite burden than smaller size groups. Environmental parameters such as rainfall, water temperature, dissolved oxygen, and transparency was found to influence infection dynamics, with monsoon conditions favoring parasite establishment and transmission. The study highlights the importance of environmental and host-related factors in regulating *Pallisentis* spp. infections and provides baseline information for fish health monitoring and sustainable fisheries management in Bihar.

Keywords- *Channa punctata*; *Pallisentis* spp.; Prevalence; Population dynamics; Environmental factors; Muzaffarpur District.

I. INTRODUCTION

Freshwater fishes harbor a diverse range of parasites that significantly influence fish health, growth, survival, and productivity. Among these, helminth parasites constitute an important component of aquatic ecosystems and are widely used as indicators of environmental and host health. *Channa punctata* (Bloch, 1793), commonly known as the spotted snakehead, is an economically important freshwater fish widely distributed in India. Despite its nutritional and commercial value, parasitic infections remain a major challenge affecting fish health, growth, and productivity (Woo, 1995; Chandra, 2006).

Among the intestinal helminths of freshwater fishes, acanthocephalans of the genus *Pallisentis* are commonly reported from channid fishes. These parasites

attach to the intestinal wall by a spiny proboscis, causing tissue damage, inflammation, and impaired nutrient absorption. Recent molecular studies have improved the understanding of the taxonomy and diversity of *Pallisentis* species in Indian freshwater fishes (Rana & Kaur, 2021).

The prevalence and intensity of parasitic infections are influenced by environmental factors such as temperature, rainfall, water quality, and intermediate host availability, as well as host characteristics including size, sex, and feeding behavior (Marcogliese, 2001; Poulin, 2007). Seasonal variation in helminth infections has been widely documented, with infection levels often increasing under favorable environmental conditions. Host size has also been reported to influence parasite burden in *C. punctata* (Kumar et al., 2023).

Seasonal variation in parasitic infections has been widely reported in freshwater fishes. Environmental factors such as temperature, rainfall, dissolved oxygen, and host availability influence parasite transmission and establishment. Previous studies have demonstrated higher prevalence and intensity of helminth infections during the monsoon and rainy seasons when environmental conditions favor parasite development and intermediate host abundance (Ajit & Yuvraj, 2015; Chandra, 2011). Host-related factors such as body size, sex, and feeding habits also affect infection patterns, with larger fishes often exhibiting higher parasite burdens (Prasenjit, 2017).

Pallisentis species are among the most common acanthocephalan parasites reported from *C. punctata* and other channid fishes (Kaur, 2012). These parasites attach to the intestinal wall through a spiny proboscis, causing tissue damage, inflammation, and impairment of nutrient absorption, thereby affecting host health and productivity.

Despite considerable progress in fish parasite taxonomy and ecology, information on the occurrence and population dynamics of *Pallisentis* infections in *Channa punctata* from Bihar remains limited. Therefore, the present study was undertaken to investigate the occurrence, prevalence, and population dynamics of *Pallisentis* infection in *Channa punctata* from Muzaffarpur District, Bihar, with special reference to seasonal variation and host-related factors.

II. MATERIALS AND METHODS

2.1. Study Area

The present investigation was conducted in Muzaffarpur District, Bihar, India, situated between 25°54'–26°23' N latitude and 84°53'–85°45' E longitude. The district is characterized by numerous ponds, wetlands, floodplain lakes, and riverine ecosystems that provide favorable habitats for freshwater fishes and their associated parasites.

2.2. Collection of Fish Samples

A total of 180 specimens of *Channa punctata* (Bloch, 1793) were collected from local fish markets and freshwater bodies of Muzaffarpur District during the study period. Fish samples were collected seasonally, comprising summer (March–June, 2025), monsoon (July–October, 2025), and winter (November–February, 2025). Immediately after collection, specimens were transported to the laboratory in ice boxes for parasitological examination.

2.3. Morphometric Measurements

The total length (cm) and body weight (g) of each fish were recorded. Based on total length, fish were categorized into three size groups: 10–15 cm, 15–20 cm, and 20–25 cm. The sex of each specimen was determined by examining the gonads during dissection.

2.4. Parasitological Examination and Identification

Fish specimens were dissected following standard parasitological procedures. The alimentary canal was removed and examined under a stereoscopic microscope. Intestinal parasites were carefully recovered, counted, washed in physiological saline, and preserved in 70% ethanol. The acanthocephalan parasites were identified as *Pallisentis* spp. based on morphological characteristics described in standard taxonomic keys.

2.5. Assessment of Infection Parameters

The occurrence of *Pallisentis* infection was evaluated using standard epidemiological indices (Bush et al., 1997):

Prevalence (%) = (Number of infected fish / Number of fish examined) × 100

Mean Intensity = Total number of parasites recovered / Number of infected fish

Mean Abundance = Total number of parasites recovered / Number of fish examined

Infection Index = Prevalence × Mean Intensity

The infection parameters were calculated season-wise, sex-wise, and size-wise to determine patterns of parasite distribution.

2.6. Recording of Environmental Parameters

During each sampling period, important physicochemical parameters of water were recorded from the collection sites. Water temperature (°C) was measured using a digital thermometer, pH using a portable pH meter, dissolved oxygen (DO; mg L⁻¹) by the Winkler method, and transparency (cm) using a Secchi disc. Rainfall data were obtained from the local meteorological department. These environmental variables were used to assess their influence on the prevalence and intensity of *Pallisentis* infection.

2.7. Statistical Analysis

All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA), and differences were considered significant at $p < 0.05$.

III. RESULT

3.1. Morphological Identification of the Parasite

The recovered specimens were identified as *Pallisentis* spp. (Phylum Acanthocephala, Family Quadrigyridae) based on their characteristic morphological features. The parasites possessed an elongated cylindrical body armed with cuticular spines on the anterior region and a retractable proboscis bearing rows of hooks, which is a diagnostic feature of the genus *Pallisentis*. Sexual dimorphism was evident, with males exhibiting a copulatory bursa at the posterior end, whereas females possessed a terminal genital opening (vulva). The combination of a hooked proboscis, spinose trunk, and distinct reproductive structures confirmed the specimens as members of the genus *Pallisentis*.

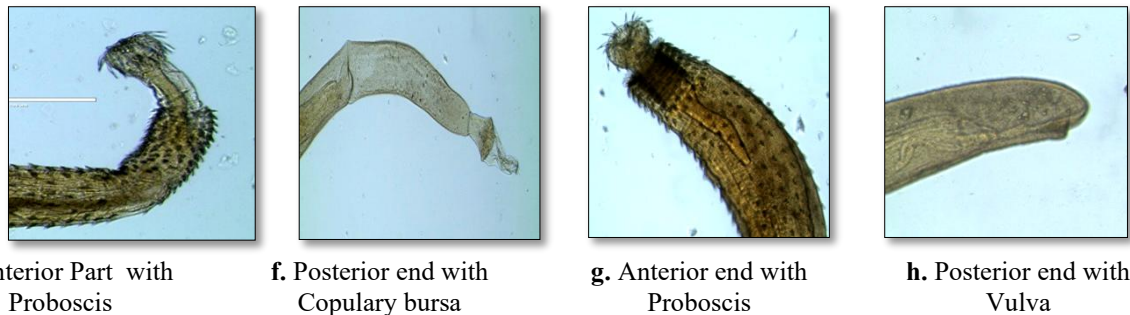


Figure: 1. *Pallisentis* spp. Male (e & f), Female (g & h)

3.2. Characteristics feature

Cylindrical, unsegmented body. Anterior retractable proboscis armed with hooks. Trunk covered with cuticular spines, especially in the anterior region.

Male with a well-developed copulatory bursa. Female with a distinct posterior vulva. Sexual dimorphism clearly evident. Typical acanthocephalan morphology consistent with *Pallisentis* spp.

Table: 1. Seasonal Prevalence of *Pallisentis* Infection in *Channa punctata*

Season	Fish Examined (n)	Fish Infected (n)	Prevalence (%)	Mean Intensity	Mean Abundance	Infection Index
Summer	60	22	36.67	3.45	1.27	126.51
Monsoon	60	38	63.33	5.18	3.28	328.11
Winter	60	29	48.33	4.03	1.95	194.81
Total	180	89	49.44	4.22	2.17	216.48

The prevalence of *Pallisentis* infection varied significantly among seasons ($\chi^2 = 8.74$, $p = 0.013$), indicating that seasonal factors influenced parasite transmission and establishment in *Channa punctata*. The highest prevalence was recorded during the monsoon season (63.33%), followed by winter (48.33%) and

summer (36.67%). Mean intensity and abundance also reached their maximum values during the monsoon season (5.18 and 3.28, respectively), suggesting favorable environmental conditions for parasite development and transmission during this period.

Table: 2. Sex-wise Distribution of *Pallisentis* Infection

Sex	Fish Examined (n)	Fish Infected (n)	Prevalence (%)	Mean Intensity
Male	90	40	44.44	3.90
Female	90	49	54.44	4.48
Total	180	89	49.44	4.22

Sex-wise analysis revealed a higher prevalence of infection in female fish (54.44%) compared to males (44.44%). However, the difference was not statistically significant ($\chi^2 = 1.82$, $p = 0.177$), indicating that host sex

had no significant effect on susceptibility to *Pallisentis* spp. infection. Similarly, female fish exhibited a slightly higher mean intensity (4.48) than male fish (3.90).

Table: 3. Size-wise Distribution of *Pallisentis* spp. Infection

Length Group (cm)	Fish Examined (n)	Fish Infected (n)	Prevalence (%)	Mean Intensity
10–15	50	16	32.00	2.75
15–20	70	34	48.57	4.12
20–25	60	39	65.00	5.36
Total	180	89	49.44	4.22

A significant variation in prevalence was observed among different size groups ($\chi^2 = 11.64$, $p = 0.003$). The highest prevalence (65.00%) and mean intensity (5.36) were recorded in the largest size group (20–25 cm), whereas the lowest prevalence (32.00%)

and mean intensity (2.75) occurred in the smallest size group (10–15 cm). These findings suggest that parasite burden increases with host size, likely due to prolonged exposure to infective stages and greater consumption of intermediate hosts.

Table 4. Season-wise physicochemical parameters recorded

Season	Water Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Transparency (cm)	Rainfall (mm)
Summer	31.5 ± 1.2	7.8 ± 0.2	5.1 ± 0.4	48 ± 3	85
Monsoon	28.2 ± 1.0	7.3 ± 0.3	4.6 ± 0.5	32 ± 4	325
Winter	21.4 ± 0.8	7.6 ± 0.2	6.8 ± 0.3	56 ± 2	22

Correlation analysis between environmental variables and infection parameters indicated a positive association between rainfall and parasite prevalence, with infection levels increasing during the monsoon season. Water temperature also showed a positive relationship with infection intensity, whereas dissolved oxygen exhibited a negative relationship. Lower dissolved oxygen concentrations during the monsoon season coincided with higher prevalence and abundance of *Pallisentis*. Water transparency demonstrated a negative association with infection levels, suggesting that turbid conditions may favor parasite transmission. The observed seasonal trends indicate that environmental factors play a significant role in regulating the population dynamics of *Pallisentis* spp. in *Channa punctata*.

Table 5. Statistical Analysis of Seasonal Variation

Parameter	χ^2 Value	p-value	Significance
Seasonal prevalence	8.74	0.013	Significant
Sex-wise prevalence	1.82	0.177	Not Significant
Size-wise prevalence	11.64	0.003	Significant

IV. DISCUSSIONS

The present study revealed that *Pallisentis* spp. is a common intestinal acanthocephalan parasite of *Channa punctata* in Muzaffarpur District, Bihar. The overall prevalence of infection was 49.44%, indicating that acanthocephalan infections constitute an important component of the helminth fauna of this economically important freshwater fish (Table 1). Similar observations have been reported from different regions of India where *Pallisentis* species are frequently encountered in channid fishes (Kaur, 2012; Gupta et al., 2012; Kumar et al., 2023).

Seasonal variation in parasite occurrence was evident in the present investigation, with the highest prevalence (63.33%), mean intensity (5.18), mean abundance (3.28), and infection index (328.11) recorded during the monsoon season, followed by winter and summer (Table 1). Statistical analysis further confirmed significant seasonal differences in infection levels ($\chi^2 = 8.74$, $p = 0.013$; Table 5). These findings are consistent with previous studies that reported increased helminth infections during the rainy and monsoon seasons (Chandra, 2011; Ajit & Yuvraj, 2015). The higher infection levels during monsoon may be attributed to

increased rainfall, flooding of aquatic habitats, enhanced survival of infective stages, and greater abundance of intermediate hosts such as crustaceans and aquatic invertebrates, which facilitate parasite transmission (Marcogliese, 2001; Poulin, 2007).

Environmental conditions recorded during the study also support this interpretation (Table 4). Monsoon season was characterized by high rainfall (325 mm), lower dissolved oxygen levels, and reduced water transparency, conditions that may favor the development and transmission of parasite larvae. Similar relationships between environmental factors and parasite prevalence have been documented by Marcogliese (2001), who emphasized the role of climatic and physicochemical variables in shaping aquatic parasite communities. Therefore, the observed seasonal pattern suggests that environmental conditions play a crucial role in regulating the population dynamics of *Pallisentis* spp. in *C. punctata*.

Sex-wise analysis showed a higher prevalence and mean intensity of infection in females (54.44% and 4.48, respectively) compared to males (44.44% and 3.90), although the differences were not statistically significant ($\chi^2 = 1.82$, $p = 0.177$; Tables 2 and 5). Similar observations have been reported by Gupta et al. (2012), who found slightly higher infection rates in female *Channa* species. The greater parasite burden in females may be associated with physiological stress during gonadal maturation and spawning, which can influence immune competence and susceptibility to infection. However, the lack of statistical significance indicates that sex was not a major determinant of *Pallisentis* spp. infection in the present study.

A significant relationship was observed between host size and parasite infection ($\chi^2 = 11.64$, $p = 0.003$; Table 5). The largest size group (20–25 cm) exhibited the highest prevalence (65.00%) and mean intensity (5.36), whereas the smallest size group (10–15 cm) showed the lowest prevalence (32.00%) and mean intensity (2.75) (Table 3). These findings agree with those of Prasenjit (2017) and Kumar et al. (2023), who reported increased parasite burdens in larger fishes. Larger hosts generally have longer exposure periods to infective stages and consume a wider variety of prey organisms that may serve as intermediate hosts. Consequently, parasite accumulation tends to increase with age and body size.

The positive association between rainfall and parasite prevalence, together with the negative relationship observed with dissolved oxygen and water transparency (Table 4), further emphasizes the

importance of environmental factors in parasite transmission. Monsoon-induced increases in nutrient input and organic matter may support intermediate host populations, thereby enhancing the completion of the parasite life cycle. Similar findings have been reported for acanthocephalan and other helminth infections in freshwater fishes from tropical ecosystems (Marcogliese, 2001; Poulin, 2007; Chandra, 2011).

The pathogenic effects of *Pallisentis* spp. should not be overlooked. These parasites attach deeply to the intestinal wall using their armed proboscis, causing tissue damage, inflammation, epithelial degeneration, and impaired nutrient absorption. Such pathological effects may adversely influence host growth, physiological performance, and disease resistance. Recent studies have also demonstrated that intestinal helminths can alter host immune responses and gut microbial composition, thereby affecting overall fish health (Kumar et al., 2024). Therefore, persistent infections may have important ecological and economic consequences for wild and cultured populations of *Channa punctata*.

V. CONCLUSIONS

The present study demonstrated that *Pallisentis* spp. is a common intestinal acanthocephalan parasite of *Channa punctata* in Muzaffarpur District, Bihar, with an overall prevalence of 49.44%. Seasonal variation significantly influenced infection dynamics, with the highest prevalence, mean intensity, and abundance recorded during the monsoon season. Host size also showed a significant positive relationship with parasite burden, whereas host sex had no significant effect on infection prevalence. Environmental factors, particularly rainfall, dissolved oxygen, and water transparency, appeared to play an important role in regulating parasite transmission and establishment. The findings highlight the ecological importance of host-parasite interactions in freshwater ecosystems and provide baseline information for monitoring fish health and developing effective management strategies for sustainable fisheries and aquaculture in Bihar.

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